

Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

1
AG84F

111 6. Sta

CATFISH FARMING

A NEW FARM CROP



CONTENTS

	<i>Page</i>
Ponds and holding vats	1
Water supply and quality	2
Water supply	2
Water quality	4
Water temperature	5
Water depth	5
Muddy water	5
Selecting catfish species	5
Catfish hatcheries	6
Brood ponds	6
Stocking brood fish	7
Handling eggs and fry	8
Growing fingerlings	9
Stocking production ponds	9
Feeds and feeding	11
Feeding fry and fingerlings	11
Feeding fish in production ponds	11
Winter feeding	13
Troubles and treatments	13
Oxygen deficiency	13
Undesirable fish	15
Muddy water	16
Shock	17
Predaceous insects	17
Snakes	17
Frogs	17
Waterweeds	17
Diseases and parasites	17
Off-flavors in fish	18
Harvesting	19
Catfish economics	20
Markets	20

Washington, D.C.

Issued November 1969

CATFISH FARMING

A NEW FARM CROP

By Roy A. Grizzell, Jr., Olan W. Dillon, Jr., and Edward G. Sullivan, *biologists*
Soil Conservation Service

Catfish farming is using ponds to produce crops of catfish by intensive management. This kind of farming requires controlling water quality; spawning, hatching, and feeding fish; and harvesting and marketing the fish crop.

A fish farmer can grow catfish in small or large ponds—one pond or many. He can market his fish in several ways—as small fish for pond stocking, as pan-size fish for food or for recreation fishing, or as large fish for brood stock.

This bulletin discusses the production of channel catfish (*Ictalurus punctatus*), blue catfish (*I. furcatus*), and white catfish (*I. catus*). All are native to America. They are suited to warm-water ponds with water temperatures above 70° F. for at least 4 months each year.

Ponds and Holding Vats

The number and size of ponds is a personal decision. Small ponds cost more per surface acre of water

than large ponds, but a fish die-off in a large pond can be a financial disaster. You can increase pond size as you gain experience.

A well-designed catfish farm could consist of about 40 surface acres of ponds. It would include five ponds of 1 acre each for breeding, rearing, and holding fish and five production ponds averaging 7 acres each. At least one holding vat would also be needed.

A catfish farm needs a water-distribution system, convenient drainage facilities, and complete protection against floodwater. Give careful attention to pond size and design, to elevation of drainpipes, and to adequacy of outlets and spillways. Remove all trees, stumps, and brush from the water area, select soil of good water-holding capacity, and provide grass cover on dams and levees.

If runoff water periodically goes through a pond, the design of the spillway is especially important. When water flows through a spillway, catfish may swim out of the pond. To prevent losing fish, the

spillway must be wide enough that the flow is less than 3 inches deep. A screened overfall installed in the spillway keeps undesirable fish from entering the pond from downstream. Excess runoff water should be diverted around the pond. Of special importance is shaping the pond bottom toward the outlet to permit drainage of all water in the pond. Assistance with site location and pond design is available from the Soil Conservation Service.

Holding vats are essential to fish farming. They are used in grading fish into size classes, for holding fish for sale or temporary storage, and in treating fish to control diseases and parasites.

Holding vats are built of wood, concrete, or glass bonded on steel. A good size is 30 feet long, 4 feet wide, and 3 feet deep. The inside of concrete vats must be smoothed or

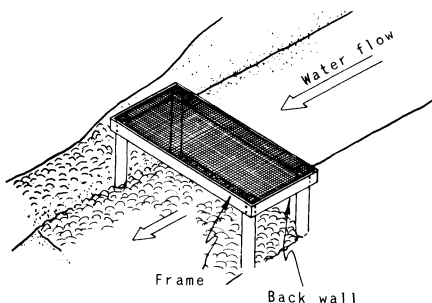
painted with asphalt or epoxy paint. Clean, aerated well or spring water must be used in holding vats during the summer.

Water Supply and Quality

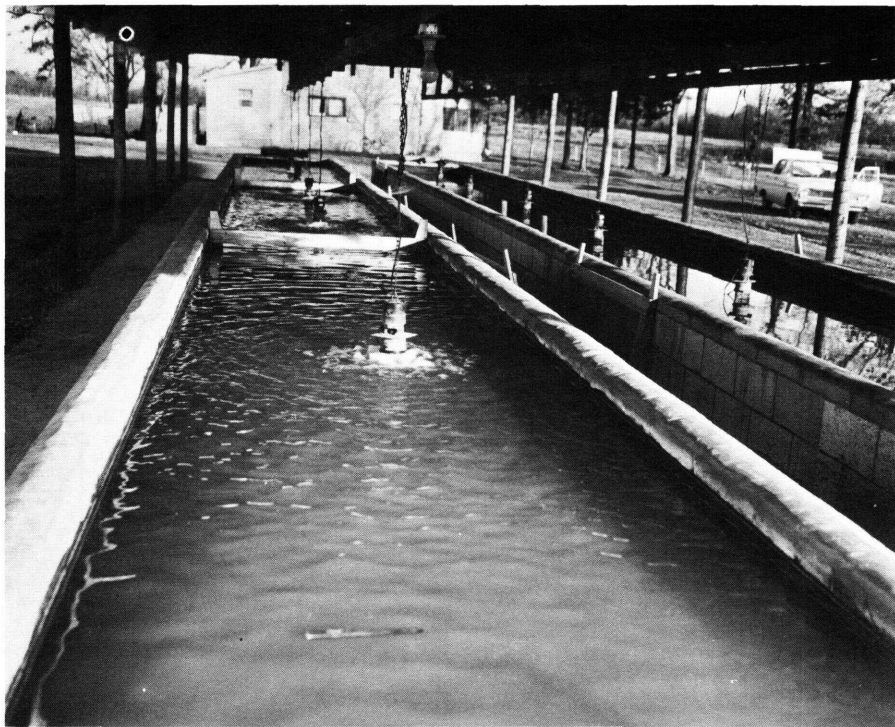
A dependable supply of good-quality water is essential for catfish farming. Water from wells, springs, streams, or runoff ponds is suitable if necessary precautions are understood and taken.

Water supply

Well water.—The best source of water is a well. Using well water avoids problems of unwanted fish, flood hazard, and muddiness. Your well should provide enough water to fill the ponds, replace the water lost through evaporation, and supply the water needed to replenish oxygen. Pond volumes are measured in acre-feet. An acre-foot is 43,560 square feet 1 foot deep. Water from wells is measured in gallons per minute (gpm). In 1 acre-foot there are 326,000 gallons. Thus, a 1,000-gpm well yields 4.4 acre-feet in 24 hours. The yield of the well determines the size of the enterprise. A well producing 1,000 gpm of water is big enough for 40 acres of



A screened overfall in the emergency spillway helps keep unwanted fish from entering the pond.



ARK-62,411

Holding vats are used for grading fingerlings, for holding fish for retail sale, for treating fish to control disease, and for holding brood fish.

ponds. Where underground water sources are unknown or questionable, a test well should be put down.

Well water often has dissolved carbon dioxide or nitrogen but no oxygen—a combination deadly to fish. Harmful gases can be dispersed and the water oxygenated by splashing the flow over baffles or through coarse screens or by spraying the water through the air before it enters the pond. A fall of 4 or 5 feet is enough to make the water safe.

Spring water.—Springs are a good source of water, but they may contain undesirable fish. The flow in dry seasons must be known to determine their adequacy. The oxygen level in spring water is usually more than 3 parts per million (ppm), but it is a good idea to check. If oxygen is below 3 ppm, the water should be aerated. Undesirable fish should be killed with an approved fish toxicant or removed by filtering the water.



ARK-62,420

A well provides the clean water needed for fish farming.

Surface water.—Water taken from a pond, stream, bayou, canal, or other surface source usually contains undesirable fish. They will get into ponds and compete with catfish unless measures are taken to keep them out. The only known way to remove fish and fish eggs satisfactorily is to pass the water through a saran or fiberglass screen filter (mesh size 907).

Water quality

Whatever the source of water, its pH, total hardness, and oxygen con-

tent must be determined. SCS conservationists, county agents, and state or federal biologists can assist in determining water quality and any needed remedial measures. The desirable pH range is between 6.5 and 8.5. If the pH is below 7.0 and the total hardness is less than 20 ppm, agricultural limestone or hydrated lime should be added. Water with a total hardness of more than 200 ppm should be treated with ammonium sulfate.

The minimum oxygen level for catfish ponds is 3 ppm. A lower level may cause a fish kill. Oxygen may be low at any time of the year.

Serious deficiencies are most likely to occur when there is a combination of high temperatures, little wind, decaying organic materials, and cloud cover for several days. Summer thunderstorms with strong winds may cause a pond to "turn-over"—mixing oxygen-deficient water from the pond bottom with surface water, thus depleting the oxygen supply. In winter oxygen may be low when snow and ice cover the pond.

Water temperature

Catfish grow rapidly if properly fed and if the water temperature is 70° F. or more. Growth is slow be-

tween 60° and 70° F. Little growth occurs when water is colder than 60° F.

Water depth

In the South deep water is not necessary for catfish farming. Ponds constructed on flat land should be about 2½ feet deep at the shallow end and sloped to 4 or 6 feet at the outlet. Ponds depending on runoff must be deep enough to carry catfish through a drought. Farther north, a depth of 8 feet or more may be necessary to prevent winterkill.

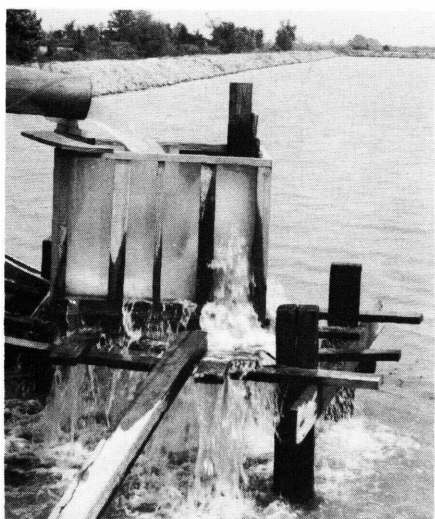
Muddy water

Fish yields are reduced by muddy water. Proper pond design and construction and a complete grass cover on all banks, slopes, dams, and levees are important ways of avoiding muddy water.

Selecting Catfish Species

Three catfish species—channel, blue, and white—can be grown in fish ponds. All have a good conversion ratio of feed to meat.

Channel catfish are most commonly grown by fish farmers. They



ARK-62,409

A filter of saran or fiberglass keeps unwanted fish and fish eggs out of the pond.

grow rapidly on feed, have excellent flavor, and bite well on sport-fishing tackle in fee-fishing ponds. Channel catfish are easily recognized by their forked tail and a rounded anal fin that has less than 30 rays. Albino channel catfish (not a separate species) are useful as novelty fish in fee-fishing ponds.

Blue catfish are often confused with channel catfish. Blues also have a forked tail but have a smaller head, an anal fin with more than 30 rays, and a slight hump at the spine of the dorsal fin. They are good sport fish. Blues grow rapidly on feed, are easy to harvest, and readily feed at the surface. They grow at about the same rate as channels the first year. After the first year, blues grow faster. They do not survive in tank trucks as well as channel catfish.

White catfish are used with channel and blue catfish in fee-fishing ponds because they bite well in the daytime when other catfish may not. They have good flavor and can survive when oxygen levels are low. Because of a large head, the percentage of dressed weight is lower than for channels and blues.

Bullheads (*I. nebulosus*) are more difficult to manage than other catfish. They often overpopulate ponds and can be troublesome to a fish farmer. In some markets they sell at a lower price.

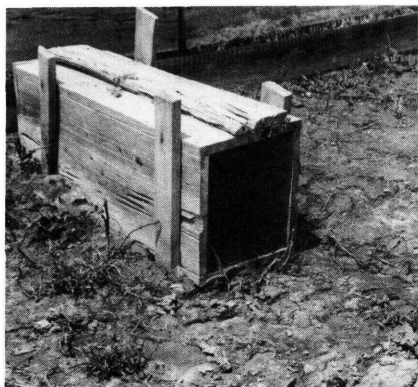
Catfish Hatcheries

For a small operation, a farmer usually buys fish for stocking. For a large fish farm, the farmer usually keeps brood fish and operates his own hatchery. He can produce stocking-size catfish to meet his needs and sell any surplus.

A catfish hatchery needs holding ponds to keep breeders in good condition, brood ponds where pairs mate and lay their eggs, and rearing ponds or troughs for the young fish. Some hatcheries include hatching troughs in which the eggs are placed for hatching.

Brood ponds

Brood ponds usually are about 1 to 2 acres. Catfish spawn best if boxes,



ARK-62,415

Boxes are good spawning devices. Cans, smooth tile, or other containers are also suitable.

10-gallon milk cans, kegs, barrels, hollow logs, or smooth tile are available. Anchor these devices securely to the pond bottom at depths of 2 to 4 feet and 20 to 30 feet apart. Paint all metal containers inside and out with asphalt paint.

During the winter or early spring brood ponds should be drained and the bottoms disked lightly. If the soil is acid, apply limestone. Fill the ponds at least 30 days before spawning is expected.

Fertilize the water at the rate of 100 pounds of 8-8-2 or its equivalent per surface acre. Apply fertilizer at 10-day intervals until you cannot see a 6-inch white disk 13 inches under the water surface. Fertilize again when you can see the white disk.

Stocking brood fish

Channel catfish breeders (brood fish) should be 3 or more years old, blue catfish 4 or more. Except during the spawning season keep the fish in holding ponds, separated by sex.

Place the breeders in brood ponds in the spring when the water temperature is about 60° F. Feed them all the pellets they will eat every day. Also feed animal-protein foods such as animal livers or cut fish as

a supplement during the prespawning period.

Spawning usually occurs when the water temperature reaches 72° F. After the female lays the eggs in one of the spawning devices, the male fertilizes them and fans and guards them until they hatch.

There are two methods of spawning brood fish:

1. Pond spawning. Stock 10 to 20 pairs per surface acre. The lower rate is desirable if the young fish are to be held in the brood pond until they reach fingerling size. Males in top condition may mate successfully with a second female and care for a nest a second time. A good stocking ratio is 22 females to 20 males. Place 22 containers in the pond.
2. Pen spawning. Provide an individual pen with a spawning device for each pair of brood fish. Heavy-duty wire netting or fencing material 4 feet high with a 2-inch mesh is best. A rectangular pen 4 feet wide and 10 feet long is commonly used, or a 20-foot length of fence can be joined to make an oval pen. Place the pens in water 3 feet deep and embed the wire 6 inches in the pond bottom. Remove the female after the eggs are deposited.



N MEX-13,857

Catfish breeders are placed in brood ponds in the early spring when the water temperature is about 60° F.

Handling eggs and fry

There are several methods of handling eggs and fry. Each method has advantages and disadvantages. Which of these is best depends on the time and facilities available.

1. After the eggs hatch, the fry are left with the male until they reach fingerling size. If practical, the male should be removed when the fry become swimming fish.
2. The fertilized eggs are left with the male until they hatch. The fry are then moved to troughs or rearing ponds to grow to fingerlings.
3. The eggs are removed from the spawning device as soon as they are fertilized and are hatched in a hatching trough. This method is used mostly by experienced fish farmers. Troughs are built of wood, marine plywood, or metal and usually are about 20

inches wide, 10 inches deep, and 10 feet long. The fertilized eggs are placed in a wire basket in the hatching trough. Aerated water is run through the trough. Paddles agitate the water to keep it continually moving over the eggs as the male fish does by fanning. Eggs hatch in 7 to 10 days. The sac-fry are then transferred to rearing troughs or ponds to grow to fingerling size.

ponds should be stocked with fry or small fingerlings at the rate of 15,000 per acre. If other sizes of fish are desired, a different stocking rate can be used (table 1).

Stocking Production Ponds

Fish are grown from fingerling to eating size in production ponds. These ponds range from less than 1 acre to more than 100 acres, depending on the size of the fish farm. In early spring the production ponds are stocked with fingerling catfish to grow to eating size by autumn.

The number to stock per acre depends on the size desired at the end of the growing season. Medium-size

Growing fingerlings

Properly stocked and fed, fish hatched in the spring can be at least 6 inches long by the end of October. To obtain this growth rate, rearing

TABLE 1.—Average length and weight of 1- to 2-inch fingerlings at end of first 180-day growing season

Number stocked per surface acre	Fish ¹	Total weight of fish	Average weight per thousand fish	Average length of fish
	<i>Number</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Inches</i>
40,000	30,000	600	20	4
30,000	22,500	720	32	5
20,000	15,000	900	60	6
15,000	11,250	1,050	93	7
10,000	7,500	840	112	8
5,000	3,750	675	180	9

¹ A 25-percent loss is assumed.

(4-6 inches) fingerlings stocked at 1,500 per surface acre usually average slightly more than 1 pound in a 210-day growing season. The same medium-size fingerlings stocked at 2,000 per surface acre average slightly less than a pound. Large fingerlings (10 inches long or weighing $\frac{1}{3}$ pound) if stocked at 1,200 per surface acre average about 2 pounds at the end of the growing season. If the growing season is shorter than 210 days, you need to stock large fingerlings.

The following stocking rates are practical:

1. In impoundments such as farm ponds that depend on runoff water and if no lift pumps are available, 750 to 1,000 fish per surface acre.
2. In ponds having a dependable water supply:
 - a. If fish are 4 to 6 inches long, 1,500 to 2,000 per surface acre;
 - b. If fish are 10 inches long or weigh $\frac{1}{3}$ pound, 1,200 fish per surface acre;
 - c. If fish are 2 years old and weigh $\frac{1}{2}$ to 1 pound each, 700 to 800 per surface acre.
3. In long narrow ponds through which water flows at the rate of at least 150 gpm, 3,500 to 5,000 per surface acre.

Proper stocking can be done only by being able to determine the number of fish placed in the pond. It is impractical to actually count them, but you can determine the desired number on the basis of weight. This can be done in two ways: (1) Count the number of fish in a known weight. Example: If there are 100 fish in 1 pound and you want to stock 2,000 fish, weigh out 20 pounds of fish. (2) Measure the length of the fish and use table 2. Example: Fish 3 inches long weigh 10 pounds per 1,000 fish. If you want to stock 2,000 fish, weigh out 20 pounds of fish.

TABLE 2.—Average length and weight of channel catfish

Length (inches)	Weight per thousand fish	Weight of individual fish
	<i>Pounds</i>	<i>Ounces</i>
1	1.3	—
2	3.5	—
3	10	—
4	20	—
6	60	—
8	112	—
10	328	5.25
12	509	8.2
14	850	13.6
16	1,290	21

Feeds and Feeding

Good catfish feed should contain 28 to 32 percent protein, no less than 5 percent fat, and 10 to 15 percent fiber. A minimum of 8 percent of the ration should be from fish meal. The rest of the ingredients may vary according to availability.

Feeds are sold as finely ground mash and as floating or sinking pellets. Floating pellets cost more but enable you to observe whether the fish are feeding. If you see no feeding activity, take steps immediately to find the cause. Channel catfish must be trained to eat floating feeds. This may take a week or more. Blue catfish readily take floating feeds.

A 1/8-inch pellet is usually used for fingerlings and a 3/8-inch pellet for fish weighing 1/2 pound or more. Some farmers use a 5/8-inch pellet for all sizes of fish with good results. Ground mash is used primarily for feeding fry.

Check hardness of the pellets regularly. When a pellet is dropped in water, 90 percent should remain together after 10 minutes.

Feeding fry and fingerlings

Fry should be fed as soon as they leave the nest or swim up in the hatching trough. Moisten finely

ground meal to make a mash before feeding. The meal should be similar in nutritional content to pelleted catfish feeds. In troughs, feed only the amount of feed that the fish clean up in 20 to 30 minutes. In ponds, use about 1 pound of feed for each 2 acres of water surface to start fry eating. Gradually increase the quantity of feed to the amount they clean up in 20 to 30 minutes. After fry are feeding well, increase the amount to the equivalent of 3 percent of the total weight of the fish in the pond. This weight is determined by weekly sampling.

Switch to pellets when fish are 1 inch long. Use table 3 to calculate the amount to feed according to the total number of fish and increasing size (length).

Feeding fish in production ponds

A general guide to the daily amount to feed (on basis of estimated weight of fish) according to water temperature follows.

<i>Water temperature</i>	
<i>6 inches below surface</i>	<i>Amount equivalent to</i>
Below 45° F., feed only every 4 or 5 days.....	0.5 percent
45° to 60° F.....	1 percent
60° to 70° F.....	2 percent
Above 70° F.....	3 percent

TABLE 3.—*Monthly feeding schedule*¹

[Pounds of feed per day 6 days per week, based on 3-percent-per-day program for fingerlings that average 4 inches in length at time of stocking]

Month	Amount for 300 fish (acreage not considered)	Amount based on stocking rate of 1,500 per acre
	<i>Pounds</i>	<i>Pounds</i>
March	0.2	0.5
April	0.5	3.0
May	1.0	7.5
June	1.5	12.0
July	2.0	15.0
August	2.5	20.0
September	3.5	25.0
October	3.5	² 30.0
November	2.0	20.0

¹ For December, January, and February feeding rates see p. 13.

² Do not exceed 30 pounds per day unless water is flowing through the pond.

Feed should be scattered in 3 to 4 feet of water. Feed at the same time and place each day, either early in the morning or late in the afternoon. Fish are usually fed 6 days a week.



ARK-62,414

Feed should be scattered at the same time and place each day.

Automatic feeders can be used. There are two types; both have a feed bin over the water. One has a clock and dispenses feed at timed intervals. The second has a release device in the water. Fish learn to bump the release and obtain feed. With either type avoid overfeeding by putting only the correct amount in the feeder each day.

Check the response of the fish daily by throwing out small amounts of feed. If they fail to feed vigorously, something is wrong; stop feeding until you find the trouble.

If sinking pellets are used, feed consumption can be checked by placing a 4- by 4-foot tray on the pond bottom in the feeding area before feeding. Lift the tray slowly an hour after feeding. If all the feed has not been eaten in an hour, reduce the amount fed.

Never feed more than 30 pounds per acre a day unless water is flowing through the pond. Excessive feeding usually results in an oxygen shortage.

Winter feeding

Catfish held over winter must be fed to prevent weight loss. They are also more resistant to disease and parasites if fed. When the water temperature is between 45° and 60° F., feed at the rate of 1 percent of the estimated total weight of the

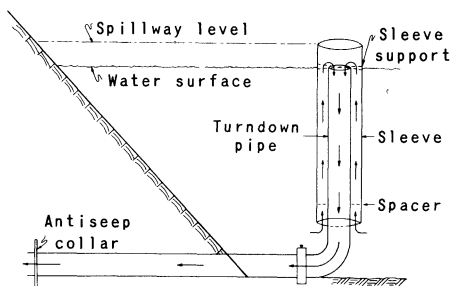
fish in the pond 6 days a week. When the water temperature is below 45° F., feed one-half of 1 percent of the weight of the fish every 4 or 5 days. In ponds holding breeders, stock fathead minnows (*Pimephales promelas*) to provide the females the extra protein necessary for egg growth and to keep the males in good condition. If fatheads are not available, feed cut fish or liver.

Troubles and Treatments

Oxygen deficiency

Catfish farmers must be prepared to correct oxygen deficiency quickly.

A continuous flow of water through the pond, even a few gallons per minute, adds oxygen to the water. If a bottom-water release device is placed in the pond, stagnant water can be removed before toxic materials accumulate.



A bottom-water release allows oxygen-deficient water to be discharged.

Some other ways to detect and prevent oxygen shortage follow:

1. Check the pond at daylight each day during warm weather since oxygen levels are lowest early in the morning. If fish are at the surface gasping for air, start aeration at once. If your water source is a well, pump fresh water into the pond over a baffle or screen. You can also use a pump to recirculate the pond water, splashing it over a baffle or through a coarse screen. Take the water from 1 to 2 feet below the pond surface. If

a pump is not available, broadcast 50 to 100 pounds of superphosphate per surface acre. This will stimulate the plants to manufacture oxygen. You should stockpile superphosphate since there may not be time to get a supply when trouble starts.

2. Fish do not feed well in oxygen-deficient water. On hot humid days, be especially cautious. Start the feeding with a small amount. If the fish fail to feed, an oxygen shortage may be developing. Discontinue feeding



ARK-62,264

A pump takes water from 1 to 3 feet below the surface and sprays it through the air to raise the oxygen level of pond water.



ARK-62,423

A lift pump is useful equipment in fish farming. Here it aerates the water.

- until the oxygen deficiency is corrected. Aeration or changing the water may be required to correct the oxygen deficiency. Resume daily feeding with small amounts until the fish again feed vigorously.
3. Changes in water color may indicate trouble. If a heavy plankton bloom clears up or changes color (usually from green to brown), expect an oxygen shortage. Stop feeding. Flush out excessive plankton blooms if enough fresh water is available. If the pond cannot be

flushed, treat it with $\frac{3}{4}$ pound of copper sulphate per surface acre.

4. From early spring to late fall it is desirable to check the water daily with an oxygen test kit. If oxygen is below 3 ppm, take remedial steps immediately.

Undesirable fish

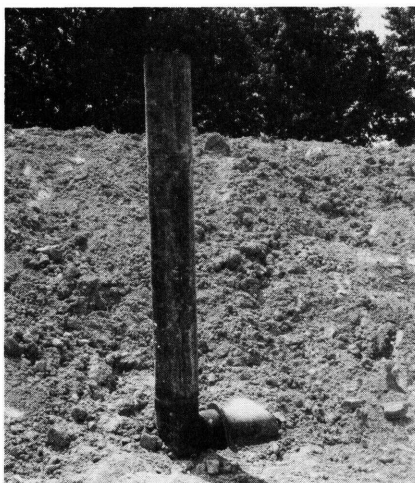
Next to oxygen deficiency, undesirable fish are the most serious problem in fish farming. They can be reduced by:

1. Draining and drying each pond after harvest. If the pond cannot be completely dried before stocking, treat the water with a fish toxicant to be sure no undesirable fish are carried over.
2. Using well water instead of surface or spring water.
3. Using a turn-down drainpipe. When the drainpipe is upright, fish cannot enter the pond unless the flow of water is reversed.
4. Filtering surface water, if it must be used, through a saran or fiberglass screen.
5. Stocking bass to prey on undesirable species of fish. Bass equal or nearly equal in size to the catfish should be stocked at the rate of 100 per acre.
6. Using selective chemicals that eliminate undesirable fish but do not harm catfish.
7. Using an overflow pipe and a screened overfall in the spillway in ponds receiving enough surface drainage to cause spillway action.

Muddy water

If muddy water is a problem, ponds can be cleared in the following ways:

1. Break bales of hay (7 to 10 per surface acre) into blocks and place them in shallow water along the edge of the pond. Repeat treatment after 10 days if necessary. Do not use hay in hot weather—its decay may cause a serious loss of oxygen.
2. On each acre of pond surface scatter a mixture of 75 pounds of cottonseed or soybean meal and 25 pounds of superphosphate per acre. Repeat treatment after 10 days if necessary. Do not use this treatment during hot weather.
3. Scatter gypsum on the pond surface. Use 200 pounds per acre if the water is slightly turbid. As much as 800 pounds per acre may be needed in very muddy water. Repeat at 7- to 10-day intervals until water clears.



ARK-62.417

A turn-down drainpipe can be adjusted to regulate the water level in a pond. Upright, it keeps the pond full; down, it drains the pond.

4. If buffalofish or carp are present, remove them with proper toxicants.

Shock

Catfish are extremely sensitive to sudden changes in water temperature. When moving catfish from one body of water to another, raise or lower the temperature of the water in the container in which they are transported to approximate that of the water into which they are to be placed. Temper the water in the container by slowly mixing water from the receiving pond with that in the container. If there is a great difference in temperature, the mixing should take about an hour.

Predaceous insects

To control insects that feed on catfish fry, pour a mixture of 1 quart of motor oil (SAE 30) and 2 to 4 gallons of diesel oil per surface acre on the surface of each brood pond just before or immediately after egg laying. Repeat if necessary. Pour the oil mixture on the pond when there is a slight breeze that will carry it across the surface. This mixture will not harm the fish.

Snakes

Water snakes prey on catfish and should be eliminated by shooting or

some other means. Keeping grass mowed around edges of ponds makes the area less attractive to snakes.

Frogs

Adult frogs feed mainly on insects but occasionally eat small fish. Tadpoles, however, compete with catfish for feed. Frogs can be controlled by shooting or gigging and by removing egg masses from ponds.

Waterweeds

Shallow, infertile water allows waterweeds to get a start. Good pond design provides a 2½ foot minimum depth, and early fertilization of the water helps prevent most waterweeds from growing.

A few herbicides have been approved for aquatic weed control under certain conditions. Such chemicals should be used according to the recommendations and restrictions stated on the herbicide label. If the label does not include instructions for a proposed use, such as aquatic weed control in fish ponds, the product has not been registered for that purpose and should not be used. Use may result in the fish being condemned for human consumption.

Diseases and parasites

Watch for changes in normal fish behavior. If you see sick or dead

fish, remove them promptly and flush the impoundment with fresh water if available.

Watch for reduced vigor or failure to feed, lesions or sores, and parasites. If you find a disease or parasite, start treatment immediately. Use only approved chemicals and no more than one at a time.

Observe the same precautions for chemicals used to treat fish diseases and parasites as for herbicides. Using unapproved chemicals could result in the fish being condemned for human consumption.

Do not crowd the fish or overfeed or underfeed them.

Off-flavors in fish

A serious problem in food-fish farming is occasional off-flavor of the fish. Off-flavors occur most frequently in late summer when water temperatures are high, the largest amount of feed is being used, and algal blooms are dense.

Before harvesting a pond, catch, clean, cook, and eat several fish to check for flavor. If you detect any off-flavor, delay harvesting until the cause is determined and corrected. If you detect any off-flavor after fish are harvested, hold them in vats with running fresh water for several days.

Some of the causes of and remedies for off-flavor are:

1. **Algal blooms.** Blooms can be reduced by flushing or by treating the ponds with copper sulfate. For information on using copper sulfate, consult your local SCS technician, county agent, or state or federal biologist.
2. **Muskgrass.** This alga grows from the pond bottom and has a strong musty odor. Fish grown in water with muskgrass often have the same disagreeable flavor in their flesh. If ponds are well constructed and high fertility is maintained, this plant seldom flourishes. If muskgrass occurs, treat with copper sulfate.
3. **Overfeeding.** Fish quickly absorb the taste of sour water caused by spoiled feed. Check food consumption regularly. If sour water causes off-flavor, flow fresh water into the pond and draw water from the pond bottom.
4. **Other organic matter.** Decaying organic matter, especially from trees, may give fish a musty taste. Remove all trees, stumps, and roots from ponds before filling with water. Also keep leaves and animal manure from getting into ponds.
5. **Chemicals.** Agricultural chemicals, especially when applied as spray, may drift over ponds and cause an off-flavor in fish

or even kill them. To reduce this hazard, use ground spray equipment or be certain that wind drift does not blow chemicals toward ponds.

Harvesting

Do not feed fish the day before harvest. The digestive tract of fish should be empty when they are handled or hauled.

It is best to harvest during cool weather. Often water at or near the pond bottom is oxygen deficient during the summer. The harvesting process may mix bottom water with top water and cause a lethal condition to develop rapidly. This hazard

can be reduced by pumping aerated water into the pond before harvesting.

Most harvesting seines are made of 1-inch-bar-mesh nylon and are 8 or 10 feet long from floats to foot-rope. The length required is determined by the size of the pond. On soft bottoms, a 30-strand sisal-twine footrope is more satisfactory than a lead line.

Ponds that have a firm smooth bottom gradually deepening to a harvesting basin are easily seined. Stretch the seine from bank to bank. The seine is more easily hauled if you attach a long rope to the bottom of each end. Trucks, tractors, or winches are often used to pull long seines. In well-constructed ponds 70 to 90 percent of the fish can be



ARK-62,404

Harvesting is easier with a boom operated from a truck on the levee.

harvested with good equipment. The remaining fish can be harvested by lowering the water to concentrate them in the harvesting basin.

Carrying fish from a pond to a tank truck is back-breaking labor. Mechanical equipment such as a boom mounted on the 3-point hitch of a tractor, an elevator, or similar device makes the job much easier.

Fee fishing is a good way to get a partial harvest. Fees are usually charged by the pound for the fish caught. The most successful combination for fee fishing has been channel, blue, and white catfish.

Catfish Economics

Many of the costs in catfish farming are set at the time the enterprise is started. This is the time to examine the alternatives in size and kind of enterprise and possibilities for expansion.

Pond construction is a major expense. It ranges from \$150 per acre for large ponds to more than \$900 per acre for small ponds. Costs depend on the kind of equipment used, the cost of moving soil, and the size and shape of the pond. Rectangular or odd-shaped ponds are more expensive to build than square ponds. Pond maintenance costs are \$20 or more per acre per year.

Water is another cost item. Wells, which are generally preferred as a source, vary in cost according to size, depth to water table, geologic structure, and other factors. A 6-inch well that produces 800 to 1,000 gallons per minute may cost \$4,500 to \$6,000, with pump and motor. A well of this size usually provides enough water for 40 acres of ponds. Pumping costs range from \$10 to \$15 per acre-foot of water.

Feed costs range from \$95 to \$140 per ton, depending on volume purchased, distance shipped, and type (floating or sinking). About 3,000 pounds of feed are needed to produce 1,500 pounds of fish.

A fish farmer should analyze all costs—those for taxes; labor; pond construction and maintenance; water-supply development, including pumping and quality control; feed; and harvesting and marketing.

Markets

Markets available to a catfish farmer vary. Selling to a combination of markets often yields the most profit. Some types of markets are:

1. Fingerlings. Fingerlings are priced according to size, quality, and quantity.
2. Brood fish. There is a limited market for high-quality breeders.



TENN-1049

Fee-fishing ponds are a major outlet for farm-raised catfish.

3. Fee fishing. Fish are caught with tackle and bait by the consumer who pays a fee, by the pound, for the fish caught. Fee-fishing ponds are usually located near large population centers where there is a demand for this kind of recreation.
4. Wholesale. This market requires large volumes of fish to supply cooperatives, processors, jobbers, and other large-volume outlets. Farmers usually sell fish at a lower price per pound to such markets, but their marketing costs are usually lower.
5. Retail. This market is usually for small-volume sales. Fish are sold live or dressed. Both costs and sale prices are usually higher for small lots.

CAUTION

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels. Store pesticides in original containers under lock and key — out of the reach of children and animals — and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift or in ways that may leave illegal residues.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump or crush and bury them in a level, isolated place.

NOTE: Some states have restrictions on the use of certain pesticides. Check your state and local regulations. Also, because registrations of pesticides are under constant review by the U.S. Department of Agriculture, consult your SCS conservationist, county agricultural agent, or state or federal biologist to be sure the intended use is still registered. The use of nonapproved chemicals could result in condemnation of the fish for human consumption.

